

**ONLINE COPY RHIC OPERATIONS PROCEDURES MANUAL
- VALID FOR FIVE (5) WORKING DAYS**

RHIC Operations Procedures Manual

**6.10.1.3 STAR DETECTOR POLE TIP
SUPPORT CARRIAGE HYDRAULIC SYSTEM**

Text Pages 1 through 10
Attachment(s) 1, 2, 3

Hand Processed Changes

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Revision No. 0

Approved:

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10/23/98

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Date

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RHIC-OPM 6.10.1.3

Date Issued: October 23, 1998

Category A

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**6.10.1.3 STAR Detector Pole Tip
Support Carriage Hydraulic System**

1.0 Purpose and Scope

The purpose of this procedure is to instruct STAR personnel in the correct method for manipulating the STAR Detector Pole Tip and their Support Carriages for removal and replacement of the Pole Tips from the magnet.

The scope of this procedure covers all operations that are required to remove and replace the Pole Tips from the magnet, and the manipulation of the upper pivot, lower pivot, and horizontal drives that are required motions of the Support Carriage Hydraulic System.

This procedure does not include procedures for other detector subsystems that may require specific operational procedures performed prior to the movement of the Pole Tips and the support carriages. This is left to each individual subsystem to prepare and integrate their requirements into an overall procedure for Preparing STAR Detector Subsystems for Removal or Replacement of a Pole Tip.

2.0 Responsibilities

- 2.1 The persons shown in Attachment 1 are responsible for conducting the procedure and for the documentation.
- 2.2 The cognizant engineer or the facility manager shall maintain the list of personnel trained in this procedure, Attachment 1.

3.0 Prerequisites

- 3.1 Required training to operate the Pole Tip Support Carriage Hydraulic System in manner described in section 1.0 above:
 - 3.1.1 BNL General Employee Training (GET)/(V-001).
 - 3.1.2 Pole Tip Support Carriage Hydraulic System training with previously qualified user listed in Attachment 1.
- 3.2 Confirm the readiness of the Pole Tip Support Carriages for this procedure. The following steps should be performed and logged onto Attachment 2 and then affixed to the Pole Tip Hydraulic System Logbook.

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- 3.2.1 For both Pole Tip Support Carriages, confirm that each horizontal drive cylinder is secured to the pole tip support base rails in the Assembly Building (AB) and wall mounts in the Wide Angle Hall (WAH).
- 3.2.2 For both Pole Tip Support Carriages, confirm that the four each seismic tie rods on each carriage are fully engaged, and the pivot motions are fully retracted to their mechanical stops.
- 3.2.3 For horizontal moves of the support carriages, confirm that each carriage base rail is swept clean of debris.
- 3.2.4 For horizontal moves of the support carriages confirm, by sweeping the area to ensure no equipment or personnel are in the path of the support carriages during horizontal movement.
- 3.2.5 Confirm that the hydraulic fluid level is adequate prior to operation of either of the hydraulic pump motors.
- 3.2.6 For removal of the Pole Tip from the magnet confirm that the trim coil DC power cables are disconnected, the water supply and return lines are drained and disconnected, and the coil interlock control wires are disconnected.
- 3.2.7 For removal or replacement of a Pole Tip in the magnet confirm that the procedure for, Preparing STAR Detector Subsystems for Removal or Replacement of a Pole Tip, RHIC-OPM # 6.10.x.x, has been completed.

4.0 Precautions

- 4.1 There is a potential for crushing both personnel and equipment from the movement of the Pole Tip Support Carriage in a horizontal direction. Therefore access to the area of horizontal carriage movement must be cleared of both equipment and nonessential personnel.
- 4.2 Safety glasses must be worn when connecting or disconnecting pressurized hydraulic lines to prevent possible eye injury. The hydraulic pump motor must be turned off when connecting or disconnecting hydraulic lines.
- 4.3 Damage to main power cable, control cables, and hydraulic lines to the hydraulic control unit can occur if they are not kept clear of the base rails when the support carriage is moving.

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5.0 Procedure

5.1 Power up Hydraulic Control Unit and Start Hydraulic Pump Motors

CAUTION

The main power cable should be connected to 208-volt 30 amp, 60-hz service.

- 5.1.1 Position the Pole Tip hydraulic pumping unit on the north side of either the East or West Pole Tip Support Carriage as required. Connect the electrical control cables to their corresponding connectors at the support carriage and the hydraulic lines to their corresponding manifold connections.
- 5.1.2 Connect the main power cable from the hydraulic control unit to 208-volt 30 amp, 60-hz service.
- 5.1.3 On the hydraulic control panel turn to the **ON** position the main disconnect switch.
- 5.1.4 On the hydraulic control panel **PULL OUT** the red E-stop button and turn the power knob (black knob) clockwise to turn **ON** power to the controller. Green power light will illuminate.

NOTE *In the controller main enclosure the controller power toggle switch should be left in the ON position and the PLC module key switch should be left in the run position.*

- 5.1.5 At this time the main menu should appear on the display screen which offers the options to:

- F1- retract upper pivot
- F2- extend upper pivot
- F3- retract lower pivot
- F4- extend lower pivot
- F5- retract linear cylinders
- F6- extend linear cylinders
- F7- enable/disable north linear cylinder
- F8- enable/disable south linear cylinder
- F9- pivot pump motor on/off
- F10- linear pump motor on/off
- F11- max linear travel differential synchronous; 0" to 1"

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F12- max linear travel differential independent; 0" to 90"
F13- zero upper pivot transducers
F14- zero lower pivot transducers
F15- zero linear transducers
F16- pivot tolerance synchronous; 0" to 4"

NOTE *There are two separate hydraulic pumping systems employed in the system. The linear horizontal motion has a maximum system pressure of 3000 psig, while the two upper and lower pivot motions has a maximum system pressure of 10000 psig, as preset by the factory.*

5.1.6 Press the **START MOTOR** functions F9 & F10 to turn the hydraulic pump motors on. Motors will continue to run until the same motor function F9 & F10 are toggled off.

5.2 Moving each Pole Tip Support Drive Motion

NOTE 1 *This motion control system is an open loop system and doesn't use the transducers to control motion as in a closed loop servo system. This means that the operator must control each motion visually and use the feedback transducers to enhance position control.*

NOTE 2 *Tolerance values set the positional accuracy for synchronous motions only. For the linear motion, there is a synchronous entry and independent entry, while the pivot motions have only a synchronous entry. The system will fault and motion will stop when these tolerance values are exceeded. Should the system fault during a synchronous move due to out of tolerance condition, it will be necessary to zero the transducers and restart the synchronous move.*

NOTE 3 *A positive motion or (+) direction extends the cylinders while a negative motion or (-) direction retracts the cylinders.*

NOTE 4 *The red emergency stop button when depressed will immediately stop the hydraulic pumps and prevent further movement until it has been reset.*

NOTE 5 *Function buttons that initiate motion are of the dead man style and require the operator to keep them depressed to maintain motion. Release of the function button will stop motion.*

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- 5.2.1 To move the upper pivots
 - 5.2.1.1 Set the tolerance by pressing F16 and from the keypad enter a value of 0.1.
 - 5.2.1.2 Zero the transducers by pressing F13.
 - 5.2.1.3 Press F1 to tilt forward (retract cylinders) or F2 to tilt back (extend cylinders).
- 5.2.2 To move the lower pivots
 - 5.2.2.1 Set the tolerance by pressing F16 and from the keypad enter a value of 0.1.
 - 5.2.2.2 Zero the transducers by pressing F14.
 - 5.2.2.3 Press F3 to lower (retract cylinders) or F4 to raise (extend cylinders).
- 5.2.3 To move the linear cylinders (synchronous only)
 - 5.2.3.1 Set the maximum travel differential synchronous by pressing F11 and from the keypad enter a value of 0.1.
 - 5.2.3.2 Zero the transducers by pressing F15.
 - 5.2.3.3 Toggle each cylinder to enable by pressing F7 and F8.
 - 5.2.3.4 Press F5 to withdraw (retract cylinders) or F6 to insert (extend cylinders).
- 5.2.4 To move the linear cylinders (independently only)
 - 5.2.4.1 Set the maximum travel differential synchronous by pressing F11 and from the keypad enter a value of 90.0.
 - 5.2.4.2 Zero the transducers by pressing F15.
 - 5.2.4.3 Toggle each cylinder to enable either the north cylinder by pressing F7 or the south cylinder by pressing F8.

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5.2.4.4 Press F5 to retract the enabled cylinder or F6 to extend the enabled cylinder.

5.3 Installing the Pole Tips into the Magnet

WARNING

There is a potential for crushing both personnel and equipment from the movement of the Pole Tip Support Carriage in a horizontal direction. Therefore access to the area of horizontal carriage movement must be restricted from both equipment and nonessential personnel.

NOTE 1 *This assumes that to start with, the Pole Tip is attached to the support carriage, each pivot motion is retracted to their mechanical stops, and the seismic tie rods are installed in the support carriage.*

NOTE 2 *Each pivot cylinder has attached to it a pilot operated ball check valve to prevent leak down retraction when power is removed. When the Pole Tip is attached to the support carriage, all cylinders should be retracted to their mechanical stops and locked out prior to shutting down the hydraulic control system.*

- 5.3.1 Remove the four (4) seismic tie rods from the support carriage.
- 5.3.2 Drive the support carriage towards the magnet, as per step 5.2.3, until the front of the support carriage base plate is under the magnet end ring.
- 5.3.3 With a tape, measure the vertical distance from the magnet end ring ID at 6 o'clock to the top of the support carriage base plate.
- 5.3.4 Adjust the upper and lower pivots, as per steps 5.2.1 and 5.2.2 respectively, until the vertical distance from the bottom of the Pole Tip to the top of the support carriage base plate is equal to the sum of the previous measurement and 4.25 inch +0.25" -0.00 and the Pole Tip is vertical to within 0.1 degree, using a digital level.
- 5.3.5 Drive the Pole Tip into the magnet, as per step 5.2.3, until the four Pole Tip Support Brackets make contact with the end ring. Monitor the clearance of the Pole Tip OD with respect to cable tray and other utilities in the radial gap.

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- 5.3.6 Lower the lower pivot, as per step 5.2.2, until the Pole Tip is resting on the two radial supports and the four Pole Tip Support Brackets are against the end ring.

NOTE *You may have to repeat steps 5.3.4 through 5.3.6 until Pole Tip is resting on the radial supports, the four Brackets are near contact with end ring, and the bolt holes in brackets are aligned with mating holes in the end ring.*

- 5.3.7 Install the (2 ea.) SB8-200-4.5/Wx12 Torquebolts in each Pole Tip Support Bracket and torque jackscrews as per Superbolt instructions, see Attachment 3, to a maximum of 85 ft-lbs.
- 5.3.8 Remove the (12 ea.) SB8-175-8/W Torquebolts from the upper pivot attachment to the Pole Tip, as per Superbolt instructions, see Attachment 3.
- 5.3.9 Retract the Pole Tip Support Carriage back to the seismic lockout position, as per step 5.2.3.
- 5.3.10 Install the four (4) seismic tie rods through the support carriage and into the floor anchors.
- 5.3.11 Press F9 and F10 to turn off both pivot and linear hydraulic pump motors, respectively.
- 5.3.12 Press the emergency stop button and turn the power knob (black knob) counter clockwise to shutdown display.
- 5.3.13 Turn main power disconnect switch to the **OFF** position.
- 5.3.14 Disconnect the main power cable from the 208-volt service.
- 5.3.15 Disconnect the electrical control cables and hydraulic lines, and stow all equipment.

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5.4 Removing a Pole Tip from the Magnet

WARNING

There is a potential for crushing both personnel and equipment from the movement of the Pole Tip Support Carriage in a horizontal direction. Therefore access to the area of horizontal carriage movement must be restricted from both equipment and nonessential personnel.

NOTE 1 *This assumes that to start with the Pole Tip is attached to the magnet, each pivot motion is retracted to their mechanical stops, and the seismic tie rods are installed in the support carriage.*

NOTE 2 *Each pivot cylinder has attached to it a pilot operated ball check valve to prevent leak down retraction when power is removed. When the Pole Tip is attached to the support carriage, all cylinders should be retracted to their mechanical stops and locked out prior to shutting down the hydraulic control system.*

- 5.4.1 Remove the four (4) seismic tie rods from the support carriage.
- 5.4.2 Drive the support carriage towards the magnet, as per step 5.2.3, until the front mounting face of the upper pivots are within six inch (6") of the Pole Tip mounting surface.
- 5.4.3 Adjust the upper and lower pivots, as per steps 5.2.1 and 5.2.2 respectively, until the top bearing surface of the upper pivots are 0.25 inch below the bearing surface of the Pole Tip and the upper pivots front mounting face is tilted forward one degree below vertical.
- 5.4.4 Drive the Pole Tip Support Carriage into the Pole Tip, as per step 5.2.3, until the upper pivot front mounting surfaces are in full contact with the Pole Tip mounting surface.
- 5.4.5 Raise the lower pivot, as per step 5.2.2, until contact is made between the upper pivot top bearing surface and the Pole tip.

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- 5.4.6 Drive the support carriage, as per step 5.2.3, towards the Pole tip until full contact is made between the two mounting surfaces.

NOTE *You may have to repeat steps 5.4.3 through 5.4.6 until both upper pivot top bearing and front mounting surfaces are in full contact with the Pole Tip mounting surfaces.*

- 5.4.7 Install the (12 ea.) SB8-175-8/W Torquebolts into the upper pivot attachment to the Pole Tip, and torque each jack screw as per Superbolt instructions, see Attachment 3, to a maximum of 75 ft-lbs.

- 5.4.8 Remove the (2 ea.) SB8-200-4.5/Wx12 Torquebolts in each Pole Tip Support Bracket, as per Superbolt instructions, see Attachment 3.

- 5.4.9 Raise the upper pivots, as per step 5.2.1, until the Pole Tip begins to tilt back.

- 5.4.10 Raise the lower pivots, as per step 5.2.2, until the Pole Tip OD is just clear of the two radial supports.

- 5.4.11 Lower the upper pivots, as per step 5.2.1, until the Pole Tip is vertical to within 0.1 degree, using a digital level.

NOTE *You may have to repeat steps 5.4.10 and 5.4.11 until the Pole Tip is in a vertical position and clear of contact with the two radial supports. Monitor the Pole Tip OD for clearance with the cable trays and other utilities in the radial gap.*

- 5.4.12 Retract the Pole Tip Support Carriage back to the seismic lockout position, as per step 5.2.3.

- 5.4.13 Lower both upper and lower pivots, as per step 5.2.1 and 5.2.2 respectively, until the are resting on their mechanical stops.

- 5.4.14 Install the four (4) seismic tie rods through the support carriage and into the floor anchors.

- 5.4.15 Press F9 and F10 to turn off both pivot and linear hydraulic pump motors, respectively.

- 5.4.16 Press the emergency stop button and turn the power knob (black knob) counter clockwise to shutdown display.

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5.4.17 Turn the main power disconnect switch to the **OFF** position.

5.4.18 Disconnect the main power cable from the 208-volt service.

5.4.19 Disconnect the electrical control cables and hydraulic lines, and stow all equipment.

6.0 Documentation

6.1 The operator will record in the Pole Tip Support Carriage Hydraulic System logbook for each occasion that the system is used the following:

Date and Time Started
Name of Operator(s)
Prerequisite Log Sheet
Description of Move
Date and Time Completed
Any difficulties encountered

7.0 References

7.1 Hydraulic System Operator Manual; Atlantic Fluid Power, Inc.

8.0 Attachments

1. Responsible People/Operators List
2. Prerequisite Log Sheet
3. Superbolt Installation and Removal Procedure

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Attachment 1

Responsible People/Operators List

8.1 Responsibilities

- 8.1.1 The following people have been qualified to operate the STAR Detector Pole Tip Support Carriage Hydraulic System within the scope described in section 1.0 above, and to provide **On the Job Training** to additional operators.

Ralph L. Brown, Cognizant Engineer
Dave Dayton, Facilities Manager

- 8.1.2 Additional qualified operators are to be listed below.

Name	Approved By	Date

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Attachment 2

Log Sheet for Operation of the STAR Detector Pole Tip Hydraulic System

Fill out and affix to Pole Tip Support Carriage Hydraulic System Logbook.

Start Date: _____ **Time:** _____

Operator(s): _____

Prerequisites: (Initial each item to confirm completion or NA if not applicable.)

1. _____ For both Pole Tip Support Carriages, confirm that each horizontal drive cylinder is secured to the pole tip support base rails in the AB and wall mounts in the WAH.
2. _____ For both Pole Tip Support Carriages, confirm that the four each seismic tie rods on each carriage are fully engaged, and the pivot motions are fully retracted to their mechanical stops.
3. _____ For horizontal moves of the support carriages, confirm that each carriage base rail is swept clean of debris.
4. _____ For horizontal moves of the support carriages confirm, by sweeping the area to ensure no equipment or personnel are in the path of the support carriages during horizontal movement.
5. _____ Confirm that the hydraulic fluid level is adequate prior to operation of either of the hydraulic pump motors.
6. _____ For removal of the Pole Tip from the magnet confirm that the trim coil DC power cables are disconnected, the water supply and return lines are drained and disconnected, and the coil interlock control wires are disconnected.
7. _____ For removal or replacement of a Pole Tip in the magnet confirm that the procedure for, Preparing STAR Detector Subsystems for Removal or Replacement of a Pole Tip, RHIC-OPM # 6.10.x.x, has been completed.

Completion Date: _____ **Time:** _____

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Attachment 3

Superbolt Installation and Removal Procedure

1.0 Installation

NOTE 1 *Read these instructions completely before you begin! Contact Superbolt, INC. (412 279-1149) if you have any questions.*

NOTE 2 *Air or electric power wrenches of appropriate size may be used for running up jackbolts. Attempt to tighten as consistently as possible, move the power wrench frequently – do not tighten all at once. Use a standard calibrated torque wrench to verify torque values.*

- 1.1 Make sure the threads of the main torquebolt and the main thread of the hole are free of any dirt or chips.
- 1.2 Slide the hardened washer onto the torquebolt first.
- 1.3 Check the base of the torquebolt head and verify that all jackbolts are flush with the bottom of the torquebolt head.
- 1.4 Spin the torquebolt body down until the bottom of the torquebolt head is snug against the hardened washer.
- 1.5 Start by snugging the jackbolts to 10% of the final jackbolt torque value. This seats the main thread and eliminates clearances. A star pattern should be used for this initial tightening sequence.
- 1.6 For the remainder of the procedure, change to the circular pattern. Torque jackbolts (one round) to 1/3 of final torque value.
- 1.7 Torque the jackbolts (one round) to 2/3 of final torque value.
- 1.8 Finally, torque jackbolts to 100% of final torque value. Since bolts stretch, it may take several rounds of torquing until all jackbolts are fully equalized. This is especially evident for longer bolts.

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(Attachment 3 cont'd)

2.0 Removal

NOTE *Removal requires strict procedures. If a number of jackbolts are totally unloaded, the remaining jackbolts have to carry the entire load making them very hard to turn. In extreme cases they can be twisted off. Overloaded jackbolts can also cause the ends of the jackbolts to mushroom. If mushrooming occurs, the jackbolts cannot be removed from the torquebolt head without first removing the distorted ends. The intent is to slowly release the preload force, and that can only be done by controlling the turning sequence of the jackbolts. Do not use air tools for loosening of the jackbolts because they make it impossible to gradually unload the jackbolts.*

- 2.1 Use only a circular pattern for removal.
- 2.2 Loosen each jackbolt no more than ¼ turn on the first round.
- 2.3 Continue repeating until all the jackbolts have been gradually unloaded.
- 2.4 By the time you get back to the first jackbolt, it will be tight again. Repeat the process, moving in a circular pattern.
- 2.5 Usually after 2 to 3 rounds, the torquebolt can be spun out by hand. Long bolts will stretch and may require extra rounds.
- 2.6 Spin the torquebolt from the matting part.

NOTE *Before re-using the torquebolt, the jackbolts should be removed, and the jackbolts and torquebolt head cleaned and re-lubricated with Superbolt approved lubricant to insure proper jackbolt torque vs. preload performance on re-installation.*

Fill out Reading Acknowledgment Form